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U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF ENTOMOLOGY.
BULLETIN NO. 2.

REPORTS OF OBSERVATIONS

ON THE

ROCKY MOUNTAIN LOCUST

AND THE

CHINCH BUG,

TOGETHER WITH

EXTRACTS FROM THE CORRESPONDENCE OF THE DIVISION ON MISCELLANEOUS INSECTS.

WASHINGTON:
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LETTER OF SUBMITTAL.

DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY.
Washington, D. C., January 18, 1883.

SIR: I have the honor to submit for publication the second Bulletin from this Division, prepared under your instructions.

Respectfully,

C. V. RILEY,
Entomologist.

HON. GEORGE B. LORING,
Commissioner of Agriculture.

INTRODUCTION.

This Bulletin includes the report by Mr. Lawrence Bruner of his observations in the Northwest during the summer and fall of 1882; some memoranda of experiments with kerosene emulsions on the Chinch Bug by Prof. S. A. Forbes, State Entomologist of Illinois, and which he has kindly sent to the Department because undertaken at our suggestion; and extracts from the correspondence of the Division.

The general scarcity of the Rocky Mountain Locust (*Caloptenus spretus*), observed by Mr. Bruner in the regions explored, tallies with the observations made by others in the West and Northwest during the same period, so far as we have any knowledge thereof. Dr. C. A. White, on behalf of the Geological Survey, traveled up and down the Yellowstone Valley for 100 miles from its confluence with the Missouri; 50 miles up and down this latter stream, from the mouth of the Yellowstone, and 50 miles east of Glendive, on the line of the Northern Pacific Railroad. During this field-work he very kindly made observations on *C. spretus*. Very few were seen near the mouth of the Yellowstone, and but a few in the air during a portion of a single day in the latter part of August. No memorandum of the direction taken by these was made. Prof. Samuel Aughey has also furnished the following notes:

On June 21, 22, and 23, I was in the North Loup Valley, between Saint Paul and Ord, and beyond, 35 miles. During these days a few locusts were flying from the northwest towards the southeast. A few dropped here and there, so that there was no mistake as to the species. There were not enough to do any material damage even had they all alighted. I have made diligent inquiry in all directions, but failed to find where they migrated to. Some cow-boys whom I met stated that a few hatched in the sand-hills south of the Niobrara, or between the latter stream and the headwaters of the Loup. If this could be confirmed it might be inferred that those seen migrating came from that locality.

On August 21, I encountered a few locusts on top of Rattlesnake Mountain. Said mountain is 85 miles or thereabout north of Rawlins, on the Union Pacific Railroad. Height of mountain, 6,900 feet above sea-level (by my barometer). They were coming from the northwest.

A week later I found a few scattered over the ground at the head and along the valley of Powder River. I also found a very few on September 2, near Searght's Ranche, on the North Platte, about 35 miles north of the mouth of Sweetwater River.

This is a meager account, but I was on the lookout all the season, and found no *Caloptenus spretus* elsewhere.

Dr. H. A. Hagen and Mr. Samuel Henshaw, who were also out during the same period on a tour of investigation for the Northern Pacific Railroad, in Montana and Washington Territory, have informed us that,

though diligently looking for this particular locust, and inquiring of all settlers about it, they found comparatively few, and heard of nothing as to its injuries during the year. These facts, together with Mr. Bruner's full report, justify the belief that the Western farmers have little to fear from the inroads and devastations of this pest the present year, 1883.

In the general correspondence of the Division there is frequently matter and experience of interest and importance both to agriculturists and to entomologists. In these bulletins, in the future, we propose to make use of such as would seem worthy of publication, giving both the letters and the replies thereto in as condensed form as possible.

C. V. R.

REPORT OF OBSERVATIONS IN THE NORTHWEST ON THE ROCKY MOUNTAIN LOCUST.

By Lawrence Bruner.

Washington, D. C., *December* 1, 1882.

Sir: Herewith I submit a report of my trip to the Northwest during the past summer, made under your direction, for the purpose of procuring additional data and facts in reference to the history and habits of the Rocky Mountain Locust (*Caloptenus spretus*), and particularly such data as would permit of definite conclusions as to the prospects for the year 1883.

In company with Mr. J. H. Mockett, jr., of Lincoln, who acted as my assistant, I left West Point, Nebraska, on the 20th of June, going by rail to Bismarck, Dakota, and from this point proceeded by river to Fort Benton, Montana, stopping off at such points as we thought would be of interest in the furtherance of our projects.

On our arrival at Fort Benton we learned that the only practical route by which to reach Fort McLeod, British America, was by stage direct from this point. We accordingly chose this means of reaching that point, knowing that, although not exactly what you desired, it would take us through at least a portion of the country suitable for and at times occupied by *C. spretus* for breeding grounds.

On reaching Fort McLeod we found matters so entirely opposite to what we had anticipated they would be, that we not only deemed it desirable, but also profitable, to ourselves to seek quarters outside of military reign and closer to the mountains. We accordingly embraced the first opportunity, and went up to the old Government saw-mill, 45 miles to the westward, where we went into camp. At this locality we remained four weeks, devoting the time to the objects of the trip. Here we also had a boat built in which to reach the lower Saskatchewan. Of course we might have accomplished the same object by team with guide and outfit; but we concluded that this would have been too expensive in this region. The river journey also offered several inducements that the other did not, viz., an opportunity of examining the country on both sides of the river, while, at the same time, all risk of losing the outfit by theft, which would be liable to occur by team, was avoided.

After proceeding along the Saskatchewan as far as the mouth of Seven Persons' River, we came to a settlement called Medicine Hat. Here we learned that Fort Walsh could be reached without difficulty.

After several days' halt we succeeded in securing the use of a team and driver with which to reach a point from which we could again reach settlement. We therefore abandoned our boat and started across the country. On arriving at Fort Walsh we replenished our provisions. From here we struck off across the country to the eastward, and after a tedious drive of ten days reached the end of the track on the Canadian Pacific Railroad. Here we took the cars, by which we reached Winnepeg, and subsequently home.

It will be seen from the above sketch of our trip that a considerable portion of the country which you had mapped out as being worthy of traversing previous to my starting was not reached. This was in part unavoidable, on account of the difficulty of obtaining means of transportation, and also on account of the limited amount of funds at my disposal.

Throughout the country which we did examine, however, the surface characteristics were much as indicated in the large map published in the second report of the Commission, especially as to the burnable and nonburnable portions.

In making this trip I was aided materially by the liberality and kindness of the following companies, corporations, and individuals:

The Saint Paul, Minneapolis and Omaha Railway Company, for half-rate fares for myself and assistant; the Northern Pacific Railway Company, free pass for self and assistant; the Coulson Line of steamers, reduction in rates; Colonel Chipman, commander at Fort Buford, for hospitalities and other favors; United States Quartermaster Department, for transportation on steamer General Sherman; Lieutenant Robinson, at Rocky Point, for hospitalities; I. G. Baker & Co., at Fort McLeod, for favors.

I must not forget also to mention the officials here in Washington, who kindly furnished me with letters of introduction.

The report, as you will notice, is in the form of a diary for the first few pages, after which it takes the form of a narrative.

Respectfully, yours,

LAWRENCE BRUNER.

Prof. C. V. RILEY,
United States Entomologist.

Sioux City, Iowa, June 21, 1882.—Reported case of broom-corn and sugar-cane saving corn and vegetables from the attack of *C. spretus* (D. H. Talbot). One case of this kind noted by above-named gentleman, and tried by another to whom he (Talbot) imparted the information, with like result.

The manner in which the first case was arranged is as follows: On the north was first planted a strip of broom-corn; next potatoes and vegetables, or only potatoes; next to the potatoes was a strip of sugar-cane and then vegetables, after which came corn. It is claimed that

when the locusts struck the northwest corner of the field as they came from that direction with a northwest wind, they drifted by to the west, avoiding all that portion of the field to the leeward of the sugar-cane and broom-corn, but taking everything clean diagonally across where the field was unprotected by these two plants; the supposition being that the wind in passing over these plants carried with it something offensive either to the sense of scent or taste of the locust. The wild grasses of the genus Sorghum, of which several varieties occur in the West, are also shunned by this insect.

Mr. Talbot also claimed that quite a number of young locusts had hatched and were now hatching in the hills lying to the east and north of Sioux City.

Had not much time or would have gone out and examined them to see whether or not they were *C. spretus*.

Bismarck, Dak., June 24.—To-day we were out on the hills in the vicinity of the city, and found some *C. spretus*, mostly all fledged and in healthy condition; a few other species, as *C. occidentalis*, *Hippiscus coralipes*, *Stenobothrus*, &c. *C. spretus* is quite common but not numerous: no damage anticipated.

Between Bismarck and Fort Buford, at various wood-stations, *C. spretus* and other Caloptenus larvæ and pupæ were noticed, but nowhere in great numbers. At Fort Buford, June 29 and 30; young locusts of numerous species quite plentiful in the hills and flat lying to the north and northwest of the post. *C. spretus* most numerous where vegetation is rankest.

Geometrid larvæ found on a wild gooseberry bush in hills north of here.[1] Yucca moths (*Pronuba yuccasella* Riley) quite abundant on blossoms of *Y. angustifolia*; also several species of ants that appear to congregate for sweets exuded by plant. None of latter saved.

Some Meloidæ found on the blossoms of sunflower and thistle.[2] Also one species of Bee-fly.[3] Latter quite common though not abundant.

Lepidoptera quite scarce. Only a few diurnals noticed, chiefly *Pyrameis huntera*.

June 30.—Collected, on low grounds near the river, some Cleridæ on flowers. Also some Hymenoptera from weeds, where they were apparently for the purpose of destroying insects. *Caloptenus bivittatus* quite common, and even numerous at some places on the bottom lands, where they feed upon rank vegetation, weeds, &c., just as they do in Nebraska and Iowa.

Mosquitoes numerous enough to interfere with work; very ravenous in their attack. Old settlers, however, mind them but little.

Fort Buford, July 1.—Were in hills north of here, and found some interesting *Cicindelidæ* among ravines in bad-lands, quite numerous,

[1] *Eufitchia ribearia* (Fitch).

[2] *Epicauta sericans* Lec. and *E. callosa* Lec.

[3] Species of Systoechus and Triodites.

but hard to capture on account of their activity.[4] No locusts except natives and a few *C. spretus* not yet fledged.

Noticed to-day for the first time the possibility of the common Prickly Pear or Leaf Cactus being insectivorous in a measure. When anything touches the stamens while spread, they all close very quickly and retain it within their grasp until a peculiar viscid secretion is ejected.

July 3.—Visited again the bad-lands in quest of the above-mentioned Cicindelidæ, and succeeded in obtaining a few additional specimens. As noticed before, they were very hard to capture.

On the 4th saw a few locusts in the air—not more than two dozen. They were flying north.

DESCRIPTION OF THE COUNTRY AT AND ABOUT FORT BUFORD.

The surface at Buford is quite level, and is covered well with grasses. A few miles (varying from two to three) back from the river, the surface becomes rolling, and gradually very rough and almost destitute of vegetation, forming what is known in this vicinity as "bad-lands." There were locusts at this locality during the summer of 1878, though in what numbers and particulars of flights I was unable to learn. Also in 1873.

Bad-lands comprise the water-worn edge of a high plateau that extends northwest and southeast for several hundred miles. This plateau is well grassed and watered during the fore part of summer, and affords an excellent breeding ground for various species of locusts. In the fall of the year, and even in late summer, this entire country can be burned over.

On approaching Mouse River Valley the bad-land feature is again presented, and forms the eastern escarpment to this plateau—"Plateau du Coteau du Missouri." Of course spring burning could be very successfully done here, especially if the growth standing was that of two or more years. That *Caloptenus spretus* does occasionally breed over this entire region in great numbers there can be no doubt, but that it is not a permanent place of multiplication seems evident from the data obtained while at Fort Buford.

In reference to the possibility of this insect continuing to breed in this locality from year to year, or for an indefinite period, I must confess that I cannot see why it could not, unless it be in the variability of humidity during different seasons.

After leaving Buford the surface along the Missouri River differs but little from that farther down the river, sometimes widening into extensive and fertile valleys, and at other places closely hemmed in by the towering buttes and water-worn hills. The Missouri winds its way through bad-lands or plateaus, the edges of which are "bad-lands."

The formation of which the surface deposits of this section of country are composed is that of a vast shallow inland sea at times, and at others

[4] *Cicindela cinctipennis* Lec.

of brackish or other marshes, in which, or around which, grew luxuriant forests, the remains of which are now to be seen in the numerous veins of lignite coal that are exposed wherever the edges of hills have been worn by water, and also in the numerous petrified trunks of trees that are imbedded in the soil of the bluffs.

At various localities these imperfect coal veins have taken fire and so baked the overlying clay as to render its color that of brick-dust. This has occurred either by accidental fires, or oftener by spontaneous combustion caused by the chemical action inherent in the alkali soil of which the over- and under-lying strata are composed.

Up the river from Fort Buford this formation is gradually replaced by one of different character. The whitish bluffs are replaced by those of a darker color, and those the character of which is quite different. Instead of being sharp-cut, they are more rounding and almost entirely destitute of vegetation, the only plants being a few small species found chiefly on the sea-beach or on alkali flats. The soil is very loose and fragile when dry, and exceedingly tenacious when wet. It is what is known as *gumbo*. Throughout this formation from top to bottom are found many concretionary rocks that have for nuclei various species of Cephalopod mollusks, as Ammonites, Scaphites, Baculites, &c.

The surface of this formation affords but poor footing for the multiplication of locusts. But as the mouth of the Mussel Shell River is approached, these characters become less permanent, and small areas of good grass are to be seen on the uplands and gently sloping hills that lie on each side of the river. Here, too, in some of the deeper and more shaded cañons, are to be seen small clumps of pines and juniper trees. At this locality we can truthfully assert that sometimes *C. spretus* breeds. The farther this way (up stream) we come, the more pines and grass—good grass on bench-lands. Numerous locusts of different species are found here. The farther up or the closer you draw to the mountains, the more numerous become the species and individuals of these native locusts. No specimens of *C. spretus* were seen this side of the Little Rockies. True, that form known as *Melanoplus devastator* is frequently to be met with along the river bottoms among the rank vegetation, where its habits resemble those of *C. differentialis*. It seldom alights upon the ground, always jumping from one plant to another, as do various species of Acridium.

At Rocky Point, or what is known as Broadwater's Landing, we laid over a few days in order to visit the Little Rocky Mountains and the country adjacent to them. At this locality are numerous exposures of the Cretaceous rocks—very likely that group known as the Fort Pierre. Throughout the clays of which this formation is composed are great quantities of gypsum and concretions, in the center of which latter are various species of shells, &c. Like the greater portion of the country already passed over, this vicinity also partakes of the "bad-land" character, though it contains a few small groves of pines that tend to diminish the monotony.

July 11.—Early this morning we started for the Little Rocky Mountains, which lie about 25 or 30 miles to the northward. In going out to them we at first wound about among the pine-dotted hills for three or four hours, and finally came out on a high plateau covered with good grasses. This sloped gradually back to the base of the mountains, where it is quite well watered by various small streams that issue from the cañons and sink into the adjoining flats. There are several thousands of acres of good grazing land, with smaller areas capable of tillage, in the immediate vicinity of the mountains, but as the plains are traversed the soil becomes less fertile and more arid as well as alkaline.

Away from the mountains the summer rains are few and the winter snow-storms severe. While this section appears to be pretty well interspersed with bad-lands and alkali wastes, it is in reality one of the best grazing regions in Montana, being the chief winter range for the buffalo and antelope, as well as other game.

During the present and for several seasons past but very few migratory locusts have been noticed here or at any point between the Missouri and Milk Rivers, but during the years of great abundance of these insects this locality was one of its favorite haunts. Other species were never very numerous, and at times are even scarce.

This season I was unable to find more than two or three dozen specimens of locusts during the day and a half spent in collecting at this point.

These mountains are well timbered in most parts, but not with trees of large size or free of limbs. Other vegetation (as shrubs and herbs) is quite abundant, as in all other mountainous or rolling countries where a considerable amount of rain falls. The rocks are chiefly slates, sandstone, and limestone, and show some signs of volcanic action. There are some quartz leads bearing traces of iron, lead, and copper, as well as some of the precious metals. There are several thermal springs in the vicinity of the highest peak of the range. This peak is the only one which we ascended, and that only a little over half way up. We gave this peak the name of our esteemed chief, who has done so much in ascertaining the facts and in solving economic problems in reference to the Rocky Mountain Locust. *Riley's Peak* stands out in front of the main range near the head of Little Rocky Creek and to the right—one of the most imposing land marks for many miles about. It was on the lower slopes of this mountain that we killed two bears—one Silver-and tipped the other a Cinnamon—after an exciting skirmish with three of these denizens of the mountains.

These springs of which I spoke above are not hot, but of about the temperature of brook water in summer.

Our collections at this point were small, as insects of all orders appeared to be very scarce.

July 17.—To-day our journey lay along a piece of river very much superior to that passed heretofore. Numerous signs of volcanic action

were present on all sides; great crevices were filled with dark basaltic columns, and walls of the same were at many points objects of much interest and comment to the passengers.

This evening, at the mouth of Judith River, while taking on wood, I noticed a great many yellowish-green larvæ feeding on almost every variety of vegetation to be found at the locality. The willows (*Salix longifolia*), however, seemed to be its favorite food, as they were completely defoliated. I do not know what species the insect was, but have sent some on to Washington.[5] At this same locality I noticed two specimens of *Caloptenus* very closely allied to *spretus*, if not this insect, but could not get them, as they jumped away and were lost among the rose-bushes.

July 19.—To-day landed about three miles below Fort Benton, and walked up to town over the bluffs on the north side of the river. Saw a great many insects of different kinds, and collected some. Locusts much more numerous here than below. No migratory specimens among the other forms, but a few that appear to me to be new to science.

During our stay at Fort Benton much of our time was occupied in collecting the various locusts to be found in the vicinity, and also in looking for Yucca moths, &c. No data in reference to locusts additional to those already possessed from this locality. On our trip to McLeod we occasionally saw specimens of a large, dark-winged, Œdipoda-like locust[6] as well as a few others which we could not stop to capture; but very few of the migratory kind among these. Country between Benton and McLeod is all high, dry, and alkaline, and is for the most part an excellent breeding ground for all kinds of locusts. The water in a great many of the isolated springs contains a large per cent. of sulphate of magnesia, and hence is very trying on the traveler, since it is the only water to be obtained. The grasses over this stretch of country improve in quality and length as we move northward, and also as we approach the mountains.

The general surface is comparatively smooth and slopes gently away to the east, only becoming broken and somewhat barren in the vicinity of the rivers and deep coolies, where the features of the bad-lands of Dakota and eastern Montana are again repeated, though in a less degree. This entire section at a period not long past was literally overrun by buffalo, and hence can be relied on as a splendid stock range. Where buffalo range, the winters, though at times cold and severe, are comparatively free from snow, and hence are suited to winter grazing.

August 3.—Here, in the vicinity of Fort McLeod, there is a great variety of native locusts, and on the flat, stony grounds to the southwest they are quite numerous. They are mostly Œdipodinæ, with a few forms of Acridinæ. While on our journey to the mountains west of Fort McLeod we succeeded in capturing a great many of them that

[5] *Zerene catenaria* (Cramer).

[6] *Circotettix carlingiana* Thos.

were afterwards destroyed by mice during a stormy night, the tent having blown down and everything overturned. Did not get a chance to replace them afterwards, as we were kept busy arranging for our trip across the country to Winnepeg. No migratory locusts noticed to-day.

The country in this vicinity is very similar in appearance to that passed over in going from Fort Benton to this point, but, being closer to the mountains, it becomes slightly rolling, and at the same time more thickly covered with vegetation, since the rainfall is more frequent. The surface, however, in many places is very thickly covered with small stones and boulders. Of course, where such is the case, the soil is poor and the grasses thin and short, making excellent breeding spots for various species of locusts. These, too, are not overlooked by them, as can be seen from the numbers of these insects to be found on and in proximity to such spots. Here, too, we miss to a great extent many of the alkali signs so prominent out on the plains. The magnesia salts are less strong where found in springs, and the marine vegetation, *i. e.*, salt marsh and beach plants, has entirely disappeared from among the flora of the country, and hence also maritime insects are no longer to be noticed.

As we approach the mountains, more and more marked become these differences. Trees begin to be seen, shrubs and herbs become more numerous and common, and the number of flowering plants increases. It must necessarily follow that insect life also increases. This is true, for now various species of bees and wasps make their appearance among the flowers, and an occasional yellow butterfly is seen flitting across the green sward. Now and then the note of a solitary sparrow is heard, or perhaps some snipe or plover is seen running along the ground chasing a locust, or sailing gracefully in the air, uttering its sharp notes to its mate and young. By this time we have reached Pincher Creek, a small mountain stream along which are settled several ranchers who appear to be doing well. This stream heads far up in the foot-hills, where it is fed by springs and lakes filled with beautiful trout. The bed of the creek is crowded with boulders and the stream is very rapid.

After crossing over this stream we begin ascending towards the first range of foot-hills, or "hog-backs," a series of which extend in a nearly parallel direction with the main range. These small ridges are composed of a kind of sandstone that has been tilted up edgewise—the softer strata having been worn away and the harder ones left standing, and thereby causing the various ridges, one in front of the other. These various ridges are dotted here and there with groves of quaking aspens, willows, and spruces, and at other points the trailing juniper almost entirely covers the rocks. Numerous small and sparkling springs discharge their cool, limpid waters among the rich grasses that carpet the valleys and lower hillsides, all tending to make the vicinity attractive and beautiful. Here it is that we find great variety in the insect life, every little variation in surface and altitude offering some peculiar at-

traction to certain species of insects. Hence this will be a splendid collecting ground, and we will undoubtedly find some interesting forms.

Our camp was made about midway from the first of these "hog-backs" to the first low range of mountains on the bank of Mill Creek. This stream is a beautiful one, and flows through a rocky cañon that is quite picturesque with scenery. The stream heads way up among the timbered portions of Victoria Mountain, and forms a way for running the lumber material down to the saw-mills situated at the lower end of its coures.

Hymenoptera are not numerous in species, but quite plentifully represented in individuals, the most attractive being the various species of humble bees and hornets which frequent flowers. Of these insects there are quite a number of gaily-colored forms, of which we obtained a fair series. Ants, too, are very numerous, but few in species. These are chiefly under stones, but two or three species frequent decayed logs or burrow in the earth, and form hills of sticks and small stones. From some of these we obtained several parasitic beetles—one form, of which there are very likely two species, being a "pill-beetle," and the others small Staphylinidæ and allied forms. Of these we also obtained a fair representation. Orthoptera were common, and of a fair number of species. These, of course, we tried to obtain in all their varieties.

One misfortune against which we had to contend, and which I regret very much, is the loss of a large number of our pinned specimens, by mice, thus making it quite difficult to classify from alcoholic specimens alone. I had made it a point to pin all odd or new looking forms, in order to retain as nearly as possible their original colors, and as there were some of which I only obtained one or two specimens, or representatives, these are lost. Others, again, change their colors to such an extent after immersion in alcohol as to render them unrecognizable when seen fresh.

Among these were numerous forms of Caloptenus (Melanoplus), some of which very closely resemble the migratory species in many of their characters, though differing sufficiently not to be confounded with that insect. None of these, though watched very carefully, exhibited the migratory trait, except, perhaps, *Camnula atrox*, which is quite common on some of the hay flats. It did not, however, appear to gather in great numbers, or to move in unison as does *C. spretus*. None of their movements noticed by me could strictly be called migrations; but at various times I saw individuals or even small groups of them rise several yards into the air and move to some other locality from fifty feet to a hundred or more yards distant.

Such species as we found identical with those in the Western and Middle States differed in no respect from them in habits, and hence were but sparingly collected, save perhaps in a few instances.

There are some Pezotettigi that may be new. These appeared to be rather rare, and were only found high up in the mountains, and quite a

distance from camp. In habit they closely imitate *Pez. dodgei* and *Pez. obesa*. One peculiarity of all the Acrididæ of these mountain regions appears to be the great variability in coloration among different individuals of the same species. Just what the cause of this phenomenon is I was unable to learn, but that there is cause for such variations there can be no doubt.

Other orders of insects are not very numerous here, save, perhaps, Diptera and Heteroptera, and these are only numerous in individuals—the species being comparatively few. Of Diptera we noticed a few and collected such as may feed upon the eggs of locusts. Of Homopterous insects, and also those belonging to Neuroptera, we saw but very few; of these, however, we collected what we well could.

During our stay in these foot-hills we made many excursions into the surrounding country and mountains, each time finding something new or of interest. These trips were generally but of a single day's duration, as we were without horses and were obliged to return to camp at night. It was by means of these trips that we visited quite an extensive area of country, the surface of which is much varied. We therefore, without much doubt, must have obtained a fair representation of the most common forms of the insect fauna of this region.

It may appear incredible that there were so few species of Lepidoptera where so many and such beautiful flowers grow, but such is the fact. During the month that we spent collecting here we could not have seen more than seventy-five or one hundred butterflies and moths, and these all belonged to less than a dozen species.

Having remained at this locality a month, we now started for McLeod with our boat. The start was made from the mouth of Pincher Creek, going by river about 75 miles. After an exciting run over numerous rapids and shoals we reached our destination just after sunset of the same day. After lying over for three days in order to lay in a supply of provisions and other necessary articles for our down-river trip, we pulled out on the afternoon of the 4th day of September. This undertaking was one which very many advised us not to try, as they claimed that the river over a great portion of its course was unexplored and might prove to be treacherous. However we thought we would run the risk.

When we left McLeod our intention was to run as far down as the first settlement, or the first place where we could obtain transportation across country to the Assiniboine or Qu'appelle River, it being our intention, if possible, to make a portage and reach Winnepeg by these rivers in our boat. The first opportunity, however, came much sooner than we had anticipated, and much more to our desire, as it gave us an opportunity of visiting the country lying in the vicinity of Fort Walsh, as well as that to the eastward, where the great swarms of locusts of 1875 and 1876 were bred.

Before recording the occurrences of this trip, perhaps it would be

well to give the facts in reference to several interviews that I had with old settlers in reference to the movements and breeding of the migratory locust in this Northwest Territory. The first of these interviews was with Mr. William S. Gladstone, an ex-employé of the Hudson Bay Company, who first came into the country in the year 1845, and was stationed at Edmonton House. He stated that in the year 1843 some locusts were hatched as far north as that place, and also at several subsequent periods, but he did not remember dates. Could not be positive as to the directions of their flights, but knows that they did fly away. Once or twice they were quite numerous, but did no damage, as there was no chance for them to do so, there being no farming done in the country at the time.

During the summers of 1874 and 1875, locusts were quite numerous throughout all the region in the country around and between Forts McLeod and Walsh. They hatched all over, even as far north as the Red Deer and beyond. They appeared to come from the east, and to leave towards the south and southwest. These were the movements as noticed on the St. Mary's River at old Forts Hoop-up and Slide-out, trading-posts. No special notice was taken of them at this time, as every one then in the country was occupied in traffic with the Indians, and had no time to watch grasshoppers. The country away from these trading-posts, too, was wild and unknown to whites and not safe to travel through, hence the little known in reference to matters foreign to trading with savages. Since the mounted police came into the country, every season more and more of this wilderness became known and traversed, until at present there are but few localities unexplored.

Mr. Gladstone's observations in reference to the habits of the locust are substantially the same as those we made while the insect was with us.

The prevailing winds are from the west and southwest, and the climate is more mild as the mountains are approached; the cause of this feature being the influence of the "Chinook" winds that at various times during winter are wafted across the mountains from the Pacific coast, and also the sheltering influence of the pine and spruce forests as well as of the mountains themselves.

Mr. Davis's (of I. G. Baker & Co.) statements were substantially the same as those of Mr. Gladstone; therefore it is unnecessary for me to repeat them here. He, too, was stationed at the same localities, viz., Hoop-up and Slide-out.

Since the spring, or rather summer, of 1877, no locusts were seen in the vicinity of Fort McLeod, *i. e.*, not in numbers sufficiently great to cause alarm or even to damage garden vegetation, nor were any noticed in the air as far as I was able to learn.

From these data and from what observations we made individually, I would infer that at present the Northwest is comparatively free from this plague.

It is unnecessary for me to enter into a lengthy discussion here as

to the possible or probable causes for the sudden and general disappearance of this insect at this time from this vast area of country that in every respect is so admirably adapted to its increase in the greatest numbers possible; for we already know how general had become its distribution during the years 1875 and 1876, and how, in the spring of 1877, everywhere, soon after the young had been hatched, they began to dwindle from various causes already known to us, until but a very small per cent. of what had hatched remained; how these from weakness were unable to migrate in every instance, and where they succeeded and deposited their eggs, how accident after accident befell them, until they were almost entirely obliterated from the face of the earth. I need not enter upon a discussion of these facts that are already known and that have been pretty widely circulated by the Entomological Commission, of which my worthy chief was head. Aside from this, however, I consider it my duty to give all the information possible in reference to its probable appearance and movements in the future, in order that the farmers and horticulturists of our country in general may know how to plant accordingly.

For a distance of some forty or more miles below McLeod the country along the river retains the characters it has in the vicinity of the above-named place, after which it gradually changes to a high, dry, and almost level plain, the surface of which is covered by a medium growth of short grasses somewhat superior to those of the plains of western Dakota, but far inferior to those of the prairies of Nebraska, Iowa, Kansas, Minnesota, and eastern Dakota.

The river bottoms become less wide, the hills higher, and timber less abundant. At long intervals deep coulees extend back from the river into the plains and form almost impassable barriers to wagon or cart travel. These coulees in the spring-time are the beds of small streams that are formed by melting snows. Some of them support a meager growth of choke cherry and Buffalo berry bushes on their sheltered sides, but otherwise there is but little trace of vegetation which bears the semblance of shrub or tree away from the river banks.

After passing the mouth of the Old Man's or Arrow River and entering the Belly River, there begin to be traces of coal in the high and almost vertical cliffs that are now quite frequent on both sides of the river. These cliffs, for the most part, are composed of clayey soil highly impregnated with the various salts of soda and potash, and occasionally a magnesia spring is passed. But very little if any vegetation grows on these steeply-worn hills, and they look quite desolate. By the time the St. Mary's River is passed, these cliffs contain some rocks of a more substantial character; the coal signs have developed into coal seams, and now and then a stratum or perhaps a series of strata is passed that contain numerous fossils of various kinds. All these characters just noticed continue to become more and more decided from time to time until they finally culminate in a narrow gorge, like a valley,

with steep rocky and clayey walls in which are to be seen numerous signs of spontaneous combustion among the coal seams.

This condition of affairs is to be met with in the neighborhood of the mouth of the Bow River. Now all traces of tree and bush have faded from the scene; all around is a black, barren wilderness, rendered more desolate at night by the shrill howlings of the gaunt and hungry coyotes that linger about our camping ground. The river now has widened out to be quite a large stream, in most parts navigable to fair-sized steamers; and its banks are turreted and grooved into fantastic forms, reminding one of the great bad-lands of the Missouri River region. All along, wherever sufficient shelter is afforded, and also at many places where there is no shelter of any kind, on the cliffs are stuck to the rocks and stowed away in nooks and crevices countless numbers of the little mud nests of the cliff swallows (*Petrochelidon lunifrons*). These remind one of a collection of inverted funnels. All their occupants had already flown away to more genial climes, or "dived down into the mud," not to appear again until next spring, as some superstitious individuals would try to make us believe. Among these are also to be seen the nests of two other swallows, viz., the Bank Swallow (*Cotyle riparia*) and the Barn Swallow (*Hirundo horreorum*). These two species were still lingering about in small numbers. Their nests were not nearly as numerous as were those of the former species. All these swallows lived upon insects of various kinds, and judging from the great amount of excrement upon the rocks beneath the nests, they must have destroyed an incalculable number of them. Very likely half of these were locusts of the various species found in this country. This being the case I do not wonder at the scarcity of insect life along this river and in the country for many miles on either side. Besides swallows, great numbers of various kinds of hawks and falcons had their rudely-constructed eyries perched upon rocks, cliffs, and often on side-hills, while every tree of sufficient size contained from one to three or four of these rude structures.

The country lying back from the river on each side is high, dry, and generally level, and varies but little in its general appearance and character for hundreds of miles from west to east, and two to three hundred miles from north to south. Of course, at several points the general level of these great plains has been disturbed by internal forces, and small mountain groups are the result. Numerous small depressions have also been made throughout the country, too, and these are now occupied by alkaline lakes.

Soon after leaving Fort McLeod the country to the northward was all burnt over. This fire extended from Willow Creek to the Little Bow River. On the south side fires had already swept over all the country from the mouth of the St. Mary's to far below the Little Bow. Again, from the Bow to the Red D[illegible] was burnt off, as well as a greater portion of the country lying east of the mouth of Seven Per-

sons' River and between that and Fort Walsh. Between Fort Walsh and Old Wives' Lake, too, more than half of the country was burnt. At several points along the river where we camped, I made small collections of various species of locusts and other insects. These were found close to the river on little spots somewhat isolated from the other country, and hence were not reached by fires.

From the scarcity of all classes of insect life in these burnt districts, it would appear that the fires destroy the insects in great numbers. But whether this is done in time to prevent the depositing of eggs, or not, I did not learn. I found many charred bodies of locusts that apparently belonged to several species. Some of these contained eggs, and others were still in coition. They were too much disfigured, in most cases, to tell with certainty the species to which they belonged.

During the journey down the river, short excursions were made back into the country at six different points. These were from three to six miles in length, but disclosed nothing in reference to the Rocky Mountain locust, more than to give us an idea of the surface of the country. We were thus enabled to make comparisons, from time to time, of the country now being traversed with that already passed over. Although the general features of the entire country were those heretofore mentioned, we could discern a slight variation, from time to time, both in the vegetation and soil. The farther down we went the more sage-brush was seen. This sage is not the same as the sages of Wyoming and Utah, but more nearly resembles *Artemisia ludoviciana*. It grows more abundantly on sandy soil comparatively free from rocks. Several other Artemisias are also occasionally met with, but these are small and inconspicuous.

At a point about twelve miles above the mouth of Bow River, on the south side, the upland is quite sandy, and much pawed over by buffalo. Of course, this has been done several years ago, as there are but few of those animals left in the country at the present time. At various other points also there is very similar soil, one of these being several miles to the northward of Medicine Hat, or the crossing of the Saskatchewan at the mouth of Seven Persons' River. At this latter locality we hired a man with his team to take us across country to the terminus of the Canadian Pacific Railroad. Our route lay through the Cypress Hills to Fort Walsh, and thence eastward for some forty-odd miles, after which we turned to the northeast and traveled in that direction until we struck the surveyed line of the Canadian Pacific Railroad, near Rush Lake, after which we again turned east.

In making this journey a great diversity of country was passed over and a distance of about 300 miles traveled. During the first day we followed up the course of a small coulee that extends back from the Saskatchewan to the Cypress Hills, part of the time keeping the high land and at other times choosing the valley. Here also the surface was bared of its vegetation, save in a few isolated spots, by prairie

fires. At several points we made small collections of the locusts, as well as of other insects which were to be found during the short interval allotted to feeding the horses. These differed in no respect from those already collected while coming down the river.

Our second day's journey was over a portion of country much like that in the neighborhood of our camp on Mill Creek west of Fort McLeod, as a great portion of it was among the northern foot-hills of the Cypress Hills. Here the vegetation was ranker, and at many points the grasses sufficiently long and thick for good hay. Trees of a few varieties somewhat common, but not numerous, and fine streams of good water were the attractive features of this portion of Her Majesty's domain, and distinguish it from all the remainder of these great and lonely plains through which we had been traveling for the past three weeks. This range of hills is a kind of an oasis in the desert, so to speak. The Cypress Mountains—or, more properly speaking, the Cypress Hills—are not very extensive, being but about 60 miles from east to west and half that distance from north to south. The country comprised in them is very rough in parts, and in others quite level, though elevated, the summit being a plateau. This is bounded by a timbered belt to the west and north, with an occasional grove on the east. From this elevated plateau, and particularly from the timbered portions, numerous small streams of good water run off to the surrounding and lower country, where it is for the most part evaporated in small lakes and ponds. These streams have all worn for themselves deep cañons, or what in this western country are termed coulees, thus making travel very difficult in certain directions, and particularly so by the route we passed. It is useless for me to go over all this country, piece by piece, as it differs but little in its general characters from that already partially described in the foregoing pages. Suffice it to say that the greater part of it is admirably adapted to the breeding of *C. spretus* and a few allied forms of locusts.

After leaving the Cypress Hills behind, we crossed a vast expanse of nearly level prairie, well grassed, with a loose, sandy, clay soil, well impregnated with various alkalies. This section, also, is admirably fitted for the rearing of locust swarms. In fact the entire country between the Rockies on the west and the Souris River on the east is one vast hotbed, calculated to produce the largest and healthiest swarms in America. These breeding grounds must not be understood to lie altogether within Canadian territory, for such is not the case. We, too, in the United States, have a continuation of these cradles of the ravaging pest in the features of western Dakota, of Montana, Wyoming, Idaho, Utah, Nevada, Oregon, and a small portion of southeastern Washington Territory, as well as in some of Nebraska, Kansas, Colorado, Texas, and New Mexico. But with us these permanent breeding localities are more separated by high mountain ranges, timber belts, and bad-lands, as well as desert and sage-brush regions.

The question now arises, Has there been any plausible and practical means discovered during any of these extended tours by which the locusts can be exterminated? My answer to this, if direct, is *no;* if indirect, *yes.* In the first place we are to make an answer in accordance with the definition of the word *exterminated.* As I understand it, it signifies blot out, and that would require every individual insect of this species to be killed, which would be an utter impossibility. But, by various methods already described in the annual reports of this Commission created by Congress, their numbers could be and will be so killed off from time to time as to bring them under the control of their natural enemies.

During our trip this summer we saw a few locusts of the migratory species at Bismarck, Dak., at Fort Buford, and two or three specimens at intervals afterwards, but nowhere were they as numerous as most species of the "natives." Locusts were also seen in small numbers by Prof. C. A. White while in the vicinity of Glendive, Mont. Professor Aughey also saw a few at several points, and Mr. E. R. Dodge reports a *few* as having been seen in Colorado. Others were reported as having hatched this spring among the sand hills between the Niobrara and Loup Rivers. In none of these cases, however, were they sufficiently numerous to cause fear of an invasion for the following summer.

EXPERIMENTS ON CHINCH BUGS.

By Prof. S. A. Forbes.

MEMORANDA OF EXPERIMENTS RELATING TO USE OF KEROSENE EMULSIONS ON CHINCH BUGS.

Solutions with which dilutions were made.—(1) Soap suds, 1 pound soap to 10 gallons water; (2) soap suds, 1 pound soap to 20 gallons water: (3) potash, 1 pound to 50 gallons water.

EMULSIONS AS DILUTED.

	Per cent. of kerosene.
A. 2 parts kerosene, 1 part milk, 45 parts water	about 4
B. 1 part kerosene, 1 part milk, 18 parts water	5
C. 1 part kerosene, 1 part milk, 18 parts solution 1	5
D. 1 part kerosene, 1 part milk, 38 parts solution 2	2½
E. 1 part kerosene, 1 part milk, 38 parts water	2½
F. 1 part kerosene, 1 part milk, 38 parts solution 3	2½
G. 1 part kerosene, 1 part milk, 30 parts solution 2	about 3

On the 22d of July I transplanted several hills of corn to the laboratory, placing them in boxes about a foot and a half wide by two feet in length. The corn was from two to three feet in height at this time. Each hill was infested with several hundred chinch bugs, which were of various sizes, below the pupa stage. All the corn was watered once immediately after transplanting, and bore the removal well. It was kept under shelter, but in the well-lighted dome of the building, and fully exposed to the air.

Experiment 1, *July* 22, 9 *p. m.*—Applied to a single hill from half a pint to a pint of emulsion A, throwing it with a small syringe upon the bases of the stalks and surfaces of the ground. For a check upon this experiment, I applied water to another hill in the same quantity and in the same way. July 23, 9 a. m., the bugs on the first hill were still alive, but torpid. July 24, at 11 a. m., about one-fifth of the bugs were completely dead; the others were still alive, but most of them torpid. July 26, 3 p. m., thirty of the bugs were alive and back upon the stalks, apparently uninjured, but all the remainder were dead. July 27, 10 a. m., the hill was in the same condition. Treated again with emulsion B, on the 28th, when all the bugs were killed. Those on the hill to which water was applied were not injured in the least, but all were back again upon the stalks in twenty-four hours.

Experiment 2, *July* 24, 4.30 *p. m.*—Applied to another hill in the laboratory one-half pint of emulsion B. July 25, 10 a. m., four-fifths of the bugs were dead. Those alive were almost entirely under clods, and some here were also dead. On the 26th and 27th about forty bugs were found to be alive, and all the remainder dead. On a hill treated with water at the same time no effect was produced.

Experiment 3, *July* 25, 3.30 *p. m.*—Applied seven pints of emulsion B to eighteen hills of corn in the field, selecting those worst affected. The weather was very hot and dry. The solution was applied with a hand force-pump. The hills treated were surrounded by fence boards placed on edge and daubed plentifully with fresh coal tar, to prevent interference from outside. On the 26th, at 11.30 a. m., about four-fifths of the bugs were entirely dead. At 5 p. m. of the 27th the situation was unchanged.

Experiment 4, *July* 28, 11 *a. m.*—A hill of corn in the laboratory was treated with half a pint of emulsion C. At 5 p. m. the bugs were all dead but about a dozen. On the 29th, at 11 a. m., could find but four that showed signs of life. On the 31st of July fourteen bugs were alive and at work on the stalks.

Experiment 5, *July* 28, 7 *p. m.*—I treated thirteen hills of corn in the field with emulsion C, applying half a pint to each hill. The following night was cloudy but dry. On the 29th, at 9 a. m., nine-tenths of the bugs were dead, and those alive were nearly all under clods. On the 29th, at 5 p. m., from 90 to 95 per cent. were dead, piled up in masses everywhere upon the corn and ground. August 2, 5 p. m., on comparison of these hills with others adjacent, I found that the bugs upon the latter were about five times as numerous as those upon the hills which had been treated. From this and the preceding experiments I infer that the bugs were still hatching.

Experiment 6.—I spread upon a glass slide as thin a layer of emulsion D as I could apply with a camel's hair brush, and allowed five bugs to crawl over it. Four, whose bodies were reached by the fluid, died in an hour, but the one remaining was unaffected.

Experiment 7, *August* 1, 12 *m.*—Applied half a pint of emulsion E to a hill in the laboratory. August 2, 8 a. m., from one-half to two-thirds of the bugs were dead, and those alive were collected upon the highest points of ground. August 4, at 8 a. m., probably three-fourths of the bugs were found to be dead.

Experiment 8, *August* 1, 12 *m.*—Applied one-half pint of emulsion D. August 2, 9 a. m., nine-tenths of the bugs were dead. Those alive were nearly all on the ground. This dilution with soap-suds holds much better than that with water.

Experiment 9, *August* 1, 12 *m.*—Applied half a pint of emulsion F. August 2, 8 a. m., one-half of the bugs were dead; the others were on the ground and on stalks. On the 4th of August nearly all were dead.

The three above experiments were intended to test the comparative

efficiency of water, soap-suds, and a solution of potash as diluents of the emulsion. The first effects were evidently in favor of soap-suds, showing that this is at least most prompt in its action. The comparison of final effects was interfered with by the fact that about this time the bugs on all the hills commenced to die indiscriminately from some cause not clearly understood.

Experiment 10, *August* 2, 2 *p. m.*—Applied half a pint of emulsion D to the worst hill in the laboratory. August 3, 9.30 a. m., nine-tenths of the bugs were dead; the others were scattered on the ground. August 4, 8 a. m., 95 per cent. of the bugs were dead, and the others still torpid on the ground.

Experiment 11, *August* 2, 5 *p. m.*—Applied one-half pint of emulsion F to a hill in the laboratory. At 10 a. m. on the 3d fully 90 per cent. of the bugs were dead.

Additional experiments, which I have not time to detail, showed that milk is not necessary to the emulsion, which can be made at least as well with soap-suds (1 pound to 10 gallons of water), using equal parts of the oil and suds; that a mere mechanical mixture of the simple oil and water is effective, and does not injure the corn (at least, in a ratio of 5 per cent. of the oil to 95 of water); that all these fluids accomplish their purpose when poured on with a sprinkler as well as when applied forcibly in a spray, and that they kill the adult bugs as easily as the young.

S. A. FORBES.

NORMAL, ILL., *August* 22, 1882.

EXTRACTS FROM CORRESPONDENCE.

GRAPTODERA CARINATA INJURING FUCHSIAS.

By this mail I send insects which I have found eating the leaves of fuchsia much in the same way as the potato bug eats the leaves of potato vines. Having never seen anything of the kind before, I would like to know whether they are common or not. They do not seem to eat the leaves of any other plant, so far as I have been able to observe. Hoping that I am not trespassing too much on your valuable time.—[Edwin Lonsdale, Germantown, Pa., September 1, ——.

REPLY.—Your favor of yesterday and the accompanying box to hand. The insect that troubles your fuchsias is a flea-beetle, *Graptodera carinata* (family *Chrysomelidæ*). You will find a short account of this insect on the inclosed slip from the American Entomologist, Vol. III, p. 200.

THE ARMY WORM AT SARATOGA.

Inclosed please find the best specimen I could find of the worm or caterpillar which destroyed 25 acres of meadow in the town of Saratoga Springs. I would like to know if they are the genuine Army Worm. The worm is about one inch long or longer, black, with two stripes the length of the body. Please have a report sent to me.—[F. D. Curtis, Charlton, N. Y., August 21, 1882.

REPLY.— * * * The worms inclosed in this letter, although badly shriveled and almost unrecognizable, seem without doubt to be genuine Army Worms. The Department is about to publish a special bulletin on this insect, an abstract of which is contained in the forthcoming annual report. The annual report for 1879 also contains a summary of its natural history, and a brief review of the known remedies.

THE ARMY WORM IN LOUISIANA.

In relation to the specimen of the Cut-worm that has done so much damage here, I send you a good collection, which was easy to find. The early Summer Flint that I planted the 9th of July as a trial to see if it would have time to mature in the richest soil of the Red River Valley. The Cut-worms have attacked it since a week, but they are not as numerous as in May and June. These worms attack the corn in the root, and others conceal themselves in the heart of the plant, which it destroys, following to the root. It attacks the cotton when very young—about fifteen days old—which in some places it has entirely destroyed. I hope this will give entire satisfaction.—[W. J. Conder, Marksville, La., August 8, 1882.

[The specimens were genuine Northern Army Worms (*Leucania unipuncta*).]

AGROTIS INERMIS AND HALTICA PALLICORNIS INJURING SMILAX.

Accompanying this I send a worm which I have found eating my smilax. It was first found in day-time feeding, five or six plants being killed before my attention was attracted by its depredations. I noticed about the 3d instant that about 400 plants had all the young leaves and shoots entirely eaten; on looking for a cause I could see

nothing. I took a light, about eight o'clock in the evening, and killed from 20 to 25. The next night about a dozen were killed, and the night following four, and the next, one. After that I could see no signs of any until three days ago. I found one plant eaten in a different part of the bed to where the others were caught. Each night I took out a light, but could not find anything until last night, when the one sent was caught. Every morning I could see where he had been feeding; each day his appetite increased, for as much again more was eaten each night than the last. A neighboring farmer says it is the Cut-worm. The plants of smilax are from 1 to 2 feet high, quite tender and succulent. Our smilax in summer time is infested by an insect very closely resembling the cabbage or turnip fly. Will pyrethrum destroy it?—[Edwin Lonsdale, Germantown, Pa., September 14, 1882.

REPLY.—The Cut-worm accompanying your favor of the 14th instant was a specimen of the Variegated Cut-worm (*Agrotis inermis*), which you will find fully treated in my First Missouri Entomological Report, p. 72. Your remedy of hand-picking will perhaps be the most satisfactory under the circumstances. I should like to see specimens of the fly on the smilax, if you can conveniently send them to me. Pyrethrum will undoubtedly destroy them.

I send by this mail a few of the lively little insects which infest the smilax in the summer time. The cool nights seem to stop their depredations, for they do not bother us much after this date. I have put in a few leaves of smilax for you to see. They do not seem to do the smilax so much damage; only to disfigure it, rendering it unfit for sale. The leaves sent are not nearly so badly marked as they are in June and July. Hoping to hear what he really is, I thank you for your attention to what I have sent before.—[Edwin Lonsdale, Germantown, Pa., September 26, 1882.

REPLY.—Your letter of the 26th September, 1882, and the insects injurious to smilax were duly received. The latter proved to belong to a common little species of flea-beetle known as *Haltica pallicornis* Fabr. They are found on many species of plants, and not infrequently do considerable damage to those cultivated in flower gardens.

SPREAD OF THE CLOVER-LEAF WEEVIL.

Has the report relating to the *Phytonomus punctatus* appeared yet? The beetles appear to be about as destructive and plentiful as last year, *and are now found in all parts of the country about here.*—[L. D. Snook, Barrington, N. Y., September 12, 1882.

THE CORN-MEAL WORM INJURING CONFECTIONERY.

I herewith mail you some samples of moth about which I desire some information. You will find in one box two moths, and two worms which will in time develop into moths. In the other box are three lozenges, which will probably be found on examination to contain worms. Please give me their name, and state if more than one yearly crop is "raised"; also, if in your judgment a heat of 130° F., or thereabouts, applied for a period of eight or nine hours, will certainly kill the eggs. What work will give me the fullest practical information in regard to them? Your kind attention to the above will greatly oblige.—[J. W. Wickersham, New York, September 16, 1882.

REPLY.—The insect which has eaten the lozenges is the corn-meal moth (*Ephestia zeæ* Fitch). It is a very general feeder, and it is not surprising to hear of it in lozenges. In my judgment a heat of 130° F. will kill the insects in every stage, if continued for eight or nine hours, and it will probably be the simplest method of destroying them. There are probably two broods each year in New York, the moths appearing in the spring and early fall. The fullest account of this insect will be found in Dr. Fitch's 2d Report, p. 320, under the name of *Tinea zeæ*.

A SILK-SPINNING MITE.

I write for information upon a very curious occurrence to which my attention was recently directed. Last Wednesday, September 6, my father noticed that one of his large ash trees glistened and sparkled in quite a remarkable manner. Thinking it was the oozing out of sap, which in such quantities would have been fatal to the tree, he proceeded to investigate. Judge of his astonishment when he found it to be the complete covering of the tree with an exceedingly delicate, filmy, compact cob-web (?). From the ground up on the trunk some 25 feet, and extending out on most of the branches, this web reached. The covering was as complete as if a silken kerchief had been wrapped around the tree-trunk. The author of this gigantic cob-web (?) is a minute, orange-colored mite, or some say spider, with his myriads of sisters, brothers, cousins, and aunts. They were found in large masses along the tree-trunk and in the crotches. Concerning the conditions and surroundings I can only say that the tree stands in close proximity to pines, maples, apple and evergreen trees. The weather has been, the entire summer, of unprecedented dryness. Three days after its appearance the most severe storm we have had for two months developed. This somewhat tore and washed away the web, but to-day, the seventh after its first discovery, it and the mites are still there. Any information concerning this fellow and his workings which you deem expedient and have the kindness to forward, I shall be most deeply thankful for.—[Geo. W. Mansfield, Melrose Highlands, Mass., September 14, 1882.

REPLY.—Your letter of the 14th September, 1882, is duly received, together with the accompanying specimens, which prove to be a species of red mite, closely allied to the so-called "red spider" (*Tetranychus telarius*), but specifically distinct. The facts which you detail are very interesting, but have been previously observed by Mr. B. P. Mann, now of this Department, and mentioned at the Cincinnati meeting of the A. A. A. S. Should you wish to remove the mites from your tree you will probably find the use of kerosene in emulsion the most satisfactory.

THE ROCKY MOUNTAIN LOCUST.

* * * Thus far we have met but few *C. spretus*, and from present outlooks there is no possibility that we will find any numbers of this insect in this vicinity unless they should drift in from across the range. This, however, is not likely to occur, since at the present time great fires are raging in the localities where they would cross were they to come this way. We have quite a number of specimens which we will carry with us, as they might be destroyed in the mails, the roads are so rough and the care so slack between this point and Benton. Have heard it hinted that there are some locusts in the section about the Columbia and Snake Rivers that are causing some trouble. This may be true. * * * At present I do not think there is any danger of locust visitations east of the Rocky Mountains for 1883, but since leaving civilization, "God's country," as Americans call it up here, we have had no opportunity of reading the papers or hearing the news of the day. * * *—[L. Bruner, Fort McLeod, N. W. T., Canada, September 3, 1882.

AN INSECT ENEMY TO THISTLE.

I send an insect with this note, for name. Its food-plant is the Canada thistle, where it inserts its beak in the stalks. I find them so thickly on some of the plants that they almost cover the stems. But my anxiety to learn its name is on account of the relation it sustains to the ants. I wish to send some notes to the *American Naturalist* about the ants, and their behavior toward these creatures, which is more interesting than anything I ever observed among the aphides and ants. If it is undescribed, will you name it and write a description, to be inserted with my notes for the Naturalist? I am still studying ants and spiders, and have some very interesting species of the latter.—[Mary Treat, Franklin Falls, N. H., September 4, 1882.

[The insect sent proved to be *Entilia sinuata* Fabr.]

THE WINGLESS WHEAT ISOSOMA IN WASHINGTON TERRITORY.

I have this day mailed to you for investigation some wheat-straws containing the larva or grub of a fly or something else, hoping to have you make an investigation and give me what it may be. Our crop is short, and has been ever since it has infested the wheat.—[J. A. Starner, Dayton, Columbia County, Wash. Ter., September 2, 1882.

REPLY.—The specimens show the insect to be the wingless "wheat-stalk Isosoma" (*Isosoma tritici* Riley) which has been studied during the past two years from specimens received from Tennessee, Missouri, and Illinois. It is also probably the same insect referred to in the *Pacific Rural Press* of three years ago as infesting wheat in California. I cannot enter into a discussion of the insect here, but will refer Mr. Starner to the article in the annual report of this department for 1881, which is now in the printer's hands and will be issued before the end of the year.

FUNGUS GROWTH UPON HONEY DEW.

I herewith inclose a specimen of insect production which, at present, very closely resembles sponge. It is made by a multitude of small insects, having a fiber very like cotton, attached to posterior or abdomen. Particles you will observe in specimen. I have been much in the woods and fields, but never saw anything like this before, attached to leaves and branches of beech trees. There is quite a quantity of insects and product where this was found. If the matter interests you, I will take pleasure in furnishing specimens and details.—[Rev. J. A. Lyons, Johnson City, Tenn., September 4, 1882.

REPLY.—The peculiar sponge-like growth upon the beech twig which you send is a fungus (*Scorias spongiosa* Fries), started originally, without much doubt, upon the honey-like excretions of a colony of wooly plant-lice. The species of the plant-louse cannot be determined with absolute accuracy, as you have sent no winged individuals, but it is in all probability the *Schizoneura imbricator* of Fitch. The specimen is very interesting, as I have never before seen this fungus at such an early stage of its growth

ELAPHIDION VILLOSUM BORING TWIGS OF WISTARIA.

According to your request I send you to-day the "Wistaria Borers" I have collected and placed in a box, to await further results. I prefer that you should watch their development, for I am away from my office too much for that business. The smallest I have observed are about one-fourth of an inch long, and are found just inside the bark of the dead wood; the channels made by them are filled with "powder-post," and generally leave the center of the twig unless the larva is nearly grown, when it seems to strike for the center, and makes itself a home there preparatory to cutting off the limb, which you will see it does at each end of its "cave." The small larvæ are white, with a large head tipped with black. The large ones are of a honey-yellow color. The segments of the body, which are very marked, seem to serve it well for legs while in its burrow, but it is quite helpless when taken out and placed on the hand or on a table. It will move quickly along its channel when it is partly cut open, but cannot crawl at all when placed on a level surface. When you have reared the perfect form I shall be glad to hear from you in regard to it.—[M. C. Read, Hudson, Ohio, September 29, 1882.

[One of the twigs was opened, and the borer proved to be the larva of a Cerambycid, *Elaphidion villosum*.]

THE AID OF SPIDERS IN THE SPREAD OF SCALE-INSECTS.

I have reached the conclusion that spiders play a much more important role in assisting the spread of scale insect than any other insects. From the beginning of my

observations I have noticed that leaves which spiders had folded or webbed together for their nests or lairs almost always proved infested with scale, if infested trees were found in the neighborhood. This I was at first inclined to attribute solely to the protection from enemies and parasites afforded by the web and presence of the spider. No doubt, where the source of infection is near at hand, this may give a sufficient explanation of the observed facts. Lately, however, I have been examining with great care a lot of one and two year old trees which I set out myself last March. The stock from which these trees were taken was to my certain knowledge almost absolutely free from scale insect. At the time of setting, the weather was excessively dry and unfavorable; in consequence of which the trees, 600 in number, were badly checked, and to a great extent lost their tops and nearly all their leaves, so that the present growth is all new, produced during the past summer. Notwithstanding, I find to my surprise, scale insects beginning to appear on a large proportion of the plants. Upon some of them the insects have begun to spread over the branches, and the exact spot where the trouble began is no longer ascertainable. In a strikingly large number of instances I find two or more leaves bound together with silk and occupied by a spider, and the inner surfaces of these leaves completely coated with scale insect, when not a trace of the insect can be found elsewhere upon the tree. Furthermore, this lot of trees occupies a position west and north of the remainder of the grove, in the path of the prevailing [S. E.] winds. The adjoining rows of older trees, on the southeast, are many of them quite badly infested with, for the most part, chaff-scale (*Parlatoria pergandii*), there being usually a relatively small number of long-scale (*Mytilaspis gloverii*) mixed with the other species. As is often the case, the proportions of this mixture of species remains quite constant throughout the infested part of the grove. Now, I find in the newly-infested young grove these two scales mixed in about the same proportions, so that no doubt exists in my mind as to the source of their infection. As to the manner in which it has been accomplished, I submit that if, as many persons think, the young lice are transported bodily by the winds, we would have had a very different distribution from that which exists upon the older trees. The larger and heavier young of the chaff-scale would have been carried to a less distance and in smaller numbers than the long-scale. (There have been no unusual storms or very high winds during the past summer.) Again, in a chance distribution by the wind I can see no reason for any evident connection with spider-web shelters such as I have mentioned. Individual scale larvæ do not, as far as I have observed, wander far in search of such protection, and do not need it until the colony becomes sufficiently numerous to attract enemies and parasites. The part played by winds is evidently a secondary one, inasmuch as nearly all the web-inhabiting spiders make use of the wind to carry themselves and their bridges of web from tree to tree, and the spiders transport as passengers upon their bodies the migrating larvæ of the scale insect.—[H. G. Hubbard, Crescent City, Fla., September 22, 1882.

THE SEVENTEEN-YEAR CICADA IN NEW YORK.

I have deferred complying with your request to furnish you with data in regard to the extent of the seventeen-year locusts, in order to obtain all possible information on the subject in this section of the country. My means of obtaining data in this matter are quite limited, and, therefore, I can only furnish you with the following: There are two districts in this county (Yates), the towns of Torrey and Middlesex, where these locusts were prevalent in great numbers during a part of June and July. Their extent in Torrey covered an area of about four square miles, and in Middlesex, somewhat less. These towns or localities are situated at some distance from each other, one bordering on Seneca Lake and the other on Canandaigua Lake. Middlesex is situated on the western boundary of the county, and Torrey on the eastern boundary. I am also informed that these insects were prevalent in portions of the counties of Ontario, Livingston, and Wyoming, of western New York. I am not able to learn that they made their appearance in any other parts of the State. They con-

tinued about four weeks in the perfect state, and did considerable damage to orchards by piercing the small branches of the trees to deposit their eggs, and thereby destroying them. How long or far back they have made their periodical visits of seventeen years I am unable to learn, but I find a few aged citizens who have witnessed their advents four times according to the above-mentioned periods. I send you some of the wood they pierced last summer, and you may find that some of the larvæ are still in the wood. The pictorial illustrations of this insect and its various stages of being are exactly in accordance with my observations of it.—[Simon Forshay, Penn Yan, N. Y., October 9, 1882.

ENORMOUS NUMBERS OF BEETLES IN STORED GRAIN.

One of the first business men of Detroit, whose house and barn are all in one structure, is flooded with *Silvanus surinamensis*. Now a miller comes to me saying that a mill which he has just bought is full of insects. One is of the same family as that mentioned above. The other something else. What are they, please? I send several specimens. The miller has taken all his floors up. I have suggested several things, only two of which are effective, bisulphide of carbon and kerosene. I think the former can be made to do the work. We are going to give it a thorough test. Of course we know the danger. We shall run no risk. Can you give me any hints? Have you known anything like it? The *S. surinamensis* in Detroit were in pints; by putting in the barn a piece of meat any time of day one could gather a pint in short order. They were almost as bad in the house. Please advise me.—[A. J. Cook, Lansing, Mich., November 1, 1882.

REPLY.—The beetles which accompany your letter of the 1st of November, 1882, are *Palorus depressus* Fabr. and *Læmophlæus alternans* Erichs. They are both cosmopolitan insects, like most of the grain-feeders. You ask for suggestions; I can recommend nothing better than the bisulphide of carbon, if artificial heat is not available. In either case I should recommend the building of an air-tight bin to use as a quarantine for all flours in the establishment.

EAST INDIAN COTTON-WORM REMEDY.

* * * "With reference to the remedy for cotton insects, I would state that the natives in upper Burma, where cotton is largely grown for China, use *conjee-water* in a fermented state. This *conjee-water* is obtained by boiling rice, and is daily poured in small quantities into a vessel capable of holding from 8 to 10 gallons. Occasionally a little boiled rice is thrown into the vessel, and if any quantity is taken out for use it is replaced from the cook-house the following day. After fermentation has set in, a little salt and the rind of a squeezed fresh lemon is put in. The natives state they have found this preparation efficacious for not only all insects on the cotton-plant, but for other purposes, for killing those which attack tobacco and cigars."—[C. Lucas, Rangoon, British Burma, E. India, November 2, 1882.

A WATER-PROOF INSECTICIDE.

Your report of November 20 has been received, for which please accept my thanks. I have for the last few years been very much interested in entomology, or that part of it which pertains to insects injurious to vegetation, and I think I have made some experiments which may prove of general use, the results of which I have already sent to our State Agricultural Report. I find in the use of an insecticide that when used in solution the finer the spray the more effective. I also use in the solution a small amount of gum arabic or glue; if glue, I add a small quantity of bichromate of potash; this makes it to a certain extent water-proof, so that it can stand two or three showers of rain. I think this water-proofing the solutions will prove of great advantage.—[William Plumer, Lexington, Mass., January 8, 1883.

THE EFFECT OF FROST UPON SCALE-INSECTS.

Your favor of the 28th of December to hand on Saturday last. I have been carefully examining scale insects to be able to tell you the effects of the frosts on them.

We had frost on the 15th, 16th, 22d, 23d, 25th, 26th, and 30th of November; on the 1st, 2d, 3d, and 4th of December; also on the 8th a frost that hurt the orange trees that had tender growth; again, frost on the 16th, 17th, and 18th; on the 17th we had a regular freeze. I measured ice five-sixteenths inch in thickness formed during the night. This freeze hurt many trees so that they have shed their leaves. During this cold weather I have kept myself informed of the condition of the insects. After each of the frosts in November I found migratory larvæ, and no signs of damage to the insects or eggs. From my note-book I read: "November 20. Young brood hatching out." "November 25. This morning young larvæ under scales; when disturbed they run about quite lively." "November 30. Migratory larvæ under scales unhurt." "December 4. Five days' consecutive frost; no damage to insects; numerous young just settled; abundance of eggs ready to hatch." "December 8. Young larvæ alive under scales, ready to run when disturbed." "December 14. Four days' consecutive warm weather; abundance of migratory larvæ." "December 19. Three days of consecutive frost; morning of 17th (thermometer + 25° F.) found migratory larvæ running about; eggs are apparently unhurt; some moisture near; some scales appear to be from the inclosed larvæ, but no damage to them is now visible." "December 27. Several days of wet weather followed by the frost, so that the trees were constantly wet; to-day, although cloudy, the trees are dry; some larvæ are dead, but a large majority are unhurt; no eggs showing signs of injury found; migratory larvæ seen; the young recently settled broods did not appear to be any more hurt than the old ones." "December 30. Wet and cold for several days past; at noon to-day clearer and warm; no migratory larvæ out; many eggs ready to hatch; some males seen issuing." "December 31. Clear and warm; found recently-hatched larvæ and parasites; some males winged and out found dead; in some scales the mother is found dead, her eggs unhurt; old females are dead, while young larvæ settled close by them are alive; all the eggs appear to be on the point of hatching."

These observations are principally made on trees near by my house, which are in no way protected from the weather; some neighbors' trees are hurt worse and some less than mine. At some distant places I hear that the trees are much worse hurt by the frosts than they are here. If I have the opportunity I will go to some of these places and examine the coccids. From the notes you will see that if we do not have any more severe cold than we have had the insects will have a very large number to start the year with. The cold appears to have only killed the most exposed coccids; those on the defoliated twigs suffered much more than those on twigs full-leaved, but in no case, on the most exposed parts of defoliated branches, have I found all killed. I have been careful to observe this; it recalled the survival of some on the exposed sides of trees in the storm in September. They evidently have different individual powers of resistance to vicissitudes of the weather.

There has not been any actual stop to reproduction during the fall and winter, and the cold weather has only postponed hatching and maturity. This was shown by the progress made in spreading from twig to twig, but the general periodical broods appear to have been broken up into small periods, governed by the character of the weather.

There has not been the usual activity on the part of parasites, as shown by perforated scales.

The effect of the frost on the coccids here may be summed up as follows: Hatching and development retarded, a small portion of larvæ killed, but not enough to be of service to the tree.—[Jos. Voyle, Gainesville, Fla., January 1, 1883.

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